North Coast and Cascades
Science Learning Network

National Park Service
U.S. Department of the Interior

2010 RESOURCE BRIEF ANNUAL

Cover Top Jeremy Anhalt, biological technician, collects water quality samples at Chenuis Creek, Mount Rainier National Park. NPS/MORA **Bottom left** Niki Bowerman, physical science technician, places a benchmark on Austera Peak, North Cascades National Park. NPS/NOCA **Bottom right** Marilyn Erway, Bill Baccus, and Steven Fradkin on Lake Crescent to review Large Lake monitoring protocols, Olympic National Park. NPS/OLYM

This Page Park Curator Tessa Langford excavating a toilet during the 2005 Public Archaeology Field School, Fort Vancouver National Historic Site. NPS/FOVA

Opposite Page Jason Smith, biological technician, collects water quality data along the Lewis and Clark River, Lewis and Clark National Historical Park. NPS/Liang

contents

The Annual

The Resource Brief Annual is expected to be a yearly publication of the North Coast and Cascades Science Learning Network, an organization within the National Park Service established to encourage research in parks and to disseminate results to park staff and the public. This first issue of the Annual contains short briefs about natural and cultural resources and is divided into two main sections: the Inventory and Monitoring Program's Vital Signs and park specific topics.

What is the Science Learning Network?

The Science Learning Network (SLN) brings science and education together to help preserve and protect areas of national significance. Its mission is to integrate research and education to better communicate park science to the public and other NPS staff.

The Science Learning Network increases the effectiveness of communicating park research, scientific results, and the management of park resources by:

- Facilitating use of parks for scientific inquiry
- Supporting science-informed decision making
- Communicating relevance of and providing access to research knowledge
- Promoting resource stewardship through partnerships

Nationwide, there are 15 "Research Learning Centers," most located in a single national park. The SLN is a virtual center providing research and education support to all eight parks in the North Coast & Cascades Network.

In 2010, the Science Learning Network launched a website intended to serve as a science information gateway. The website, **www.nwparkscience.org**, highlights research conducted by NPS scientists monitoring park resources, historical research, and featured projects by research partners. Staff will populate the website with content throughout the year.

Dr. Jerry Freilich

Science Learning Network Coordinator
Olympic National Park

Jerry Freilich is a native of Philadelphia with a masters in Environmental Education from Cornell and a Ph.D. in ecology from the University of Georgia. He's been a naturalist, law enforcement ranger, and research ecologist at six National Parks since 1978. As Coordinator of the Science Learning Network his job is to bridge rigorous science, education, and the media to protect Northwest National Parks.

Dean Butterworth

Education Specialist
Olympic National Park

Upon graduation from the College of the Holy Cross in Worcester, MA Dean Butterworth obtained a commission in the US Navy and served as a communication officer and navigator. After completing his naval service, he obtained an elementary teaching credential through the State of Connecticut's Alternate Route to Certification program. His NPS career began in 1998 and includes assignments as an interpreter and district interpreter at five other National Parks.

Michael Liang

Visual Information Specialist
North Cascades National Park

Michael Liang began his career with the National Park Service in 2004 as a Student Conservation Association intern in the remote community of Stehekin. Throughout his summers in college, he continued to work as an interpreter at the North Cascades National Park Visitor Center. He joined the Science Learning Network in 2008, when he graduated from the University of Michigan with a degree in art and design.

SLN Steering Committee

Karen Beppler-Dorn
Superintendent
Klondike Goldrush National Historical Park-Seattle

Dean Butterworth
Education Specialist
Olympic National Park

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Michael Liang
Visual Information Specialist
North Cascades National Park

Greg Shine
Chief Ranger and Historian
Fort Vancouver National Historic Site

David Szymanski
Superintendent
Lewis and Clark National Historical Park

Jerald Weaver
Chief of Integrated Resources
San Juan Island National Historic Site

north coast and cascades **parks**

U.S. Department of the Interior
↓
National Park Service
↓
Pacific West Region
↓
North Coast and Cascades Network
↓

- **Science Learning Network**
- Inventory and Monitoring

The National Park Service is responsible for 392 park units across the United States. These parks are divided into regions and further still into networks. Each network contains parks that share common ecological and cultural features.

The eight North Coast and Cascades parks are in the mountains and lowlands of the Pacific Northwest, from the Pacific Ocean to the east slope of the Cascades Range. Tall mountains and a maritime climate produce a tremendous environmental gradient, varying in elevation from sea level to glaciers, and in annual precipitation from almost 200-inches to less than 20-inches per year. These environmental patterns shape the variety and distribution of plant and animal communities and ecosystems encompassed within the parks.

Four historic parks preserve snapshots of significant cultural milestones in the development of the Pacific Northwest. Three larger parks showcase the variety of terrestrial and aquatic ecosystems native to this region and exemplify pristine Pacific Northwest Wilderness areas.

PARK NAME	TYPE OF PARK UNIT	ACRONYM	ACREAGE	2009 VISITATION
Ebey's Landing	National Historic Reserve	EBLA	19,333	NA
Fort Vancouver	National Historic Site	FOVA	194	1,017,326
Klondike Gold Rush- Seattle	National Historical Park	KLSE	<1	54,219
Lewis and Clark	National Historical Park	LEWI	1,575	225,846
Mount Rainier	National Park	MORA	236,380	1,151,654
North Cascades	National Park Complex	NOCA	504,780	349,934
Olympic	National Park	OLYM	922,650	3,276,459
San Juan Island	National Historical Park	SAJH	1,751	274,642

Style Guide

How to Write and Submit a Resource Brief

Resource Briefs are one-page synopses summarizing resource topics and are updated annually. They are intended to be starting points, where readers can quickly learn about issues and then find links to web and print sources for further information. These briefs succinctly explain why the monitoring of a particular resource is critical, its status and trends, and a discussion of ecological or management implications.

One goal of the Science Learning Network is to have briefs written for every network Inventory and Monitoring Vital Sign as well as a number of critical park-specific topics. The SLN is committed to maintaining these briefs on an annual basis and to adding other briefs on relevant topics.

The primary audience for this communication product is park managers and interpreters. Interested members of the public will also be able to download these briefs from www.nwparkscience.org (coming in 2010).

Specifications

- Fits onto one side of one 8½" x 11" page
- Contains one or two relevant photos, maps, charts, graphs, etc.
- The text consists of three parts as summarized below, for a total of 500-700 words.

• **IMPORTANCE** A short explanation of why the resource matters. This could refer to its ecological role or its importance to humans, and should specifically pertain to the North Coast and Cascades Network. *200-250 words*

• **STATUS AND TREND** A summary of the current status and how the resource has changed over a specified period of time. This may also include an event of interest that monitoring data have captured. Depending on what is relevant to current management of the resource and which data are available, this may be only the last five years, or it may cover the last century. Indicate what is being monitored and include specific data where possible, but not data that require extensive explanations. *200-300 words*

• **DISCUSSION** The discussion section should provide concise, insightful comments on the monitoring results. The discussion could include patterns and relationships in the data, predictions, emergence of new questions, explanation of unexpected results, inconclusive nature of the data, comparisons with existing literature, and any other major findings not included in the status and trends section. A discussion also could include how management decisions were made using monitoring data, how trends or changes may impact other monitoring topics, ecological implications of an event or change, and key reason(s) for any changes that have occurred. *100-150 words*

• **GRAPHICS** The text should be accompanied by eye-catching graphics: photos, maps, and/or graphs (with captions)—that are relevant. For topics for which data are available, include graphs to show the most important trends over a relevant period of time.

To create a new resource brief, please contact Michael_Liang@nps.gov

Resources

What is Inventory and Monitoring?

Park managers are charged with keeping our National Parks "unimpaired for the enjoyment of future generations." To do this they need to understand which resources are actually present in the parks and their condition. To document status and trends of natural resources, a national program of inventory and monitoring (I&M) has been under development since 2001. The North Coast & Cascades network of parks was one of the first to begin implementing this program. I&M is designed to characterize trends in the status of the park ecosystem, to assess the efficacy of management practices, and to provide early warning of impending threats.

The I&M program is based on monitoring carefully selected "Vital Signs," chosen as sensitive indicators of the overall health of park resources. Vital Signs are physical, chemical, and biological measurements, each selected for its ability to inform park managers in a timely and cost-effective way. Vital Signs monitoring will help define the normal limits of natural variation in park resources and provide a basis for understanding future changes. Monitoring results will also be used to identify problems, to give early warning of impairment, and to suggest areas where management practices need change. Results from Vital Signs monitoring are assembled nationally and reported to Congress annually in the form of an ecological health "scorecard."

National

The National Park Service:	*www.nps.gov*
Explore Nature in the NPS:	*www.nature.nps.gov*
Research Learning Networks	*www.nature.nps.gov/learningcenters*
Inventory and Monitoring	*science.nature.nps.gov/im/index.cfm*

North Coast and Cascades Network

Science Learning Network	**www.nwparkscience.org**
Inventory and Monitoring	*science.nature.nps.gov/im/units/nccn*
Intranet I&M website (available only to NPS computers)	*www.nccn.nps.gov/im/default.aspx*

National Park Units

Ebey's Landing	*www.nps.gov/ebla*
Fort Vancouver	*www.nps.gov/fova*
Klondike Goldrush *(Seattle)*	*www.nps.gov/klse*
Lewis and Clark	*www.nps.gov/lewi*
Mount Rainier	*www.nps.gov/mora*
North Cascades	*www.nps.gov/noca*
Olympic	*www.nps.gov/olym*
San Juan Island	*www.nps.gov/sajh*

Additional Resources

Greater Yellowstone Science Learning Center	*www.greateryellowstonescience.org*

Climate

Ebey's Landing, Fort Vancouver Lewis and Clark, Mount Rainier, North Cascades, Olympic, San Juan Island

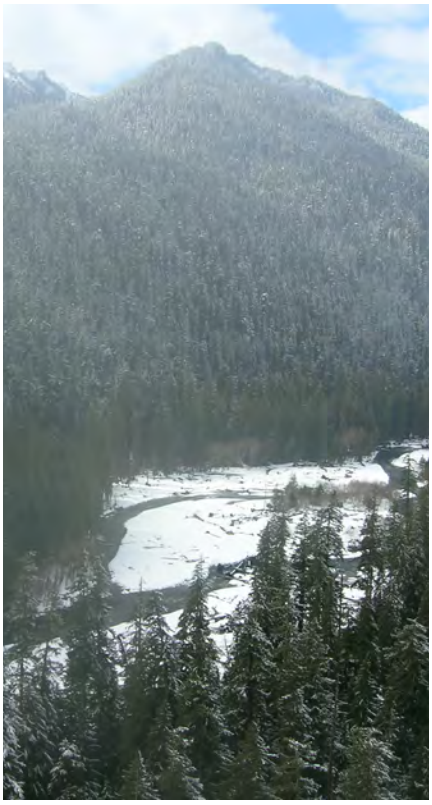
I & M RESOURCE BRIEF

Importance

Climate can be described as the prevailing weather conditions of a region averaged over a series of years. A region's climate acts as a "system driver," an overarching set of ecological and physical phenomena including wind, precipitation, temperature, and other variables associated with the global movements of vast air masses.

Climate is a primary factor regulating all biological processes and it ultimately controls the distribution of plant and animal species. The elevation of treeline and the location of prairies, rainforests and associated species is one example. Climate affects the behavior and reproduction of individual organisms. These effects can be subtle, pushing a bird's breeding season forward or back by days or weeks, or they can be dramatic, for example, stream temperatures above a certain threshold may result in the elimination of certain species of fish. In addition, extreme weather, an aspect of a region's climate, is one of the primary sources of disturbance including forest fires, avalanches, and floods.

The North Coast and Cascades Network (NCCN) monitors climate to: understand variations in other park resources being monitored; compare current and historic data to understand long-term trends; and to provide data for modeling impacts to park facilities and resources in the future. The NCCN climate monitoring program compiles data from over 40 weather stations in and adjacent to the parks, 12 of which are actually operated by the National Park Service.



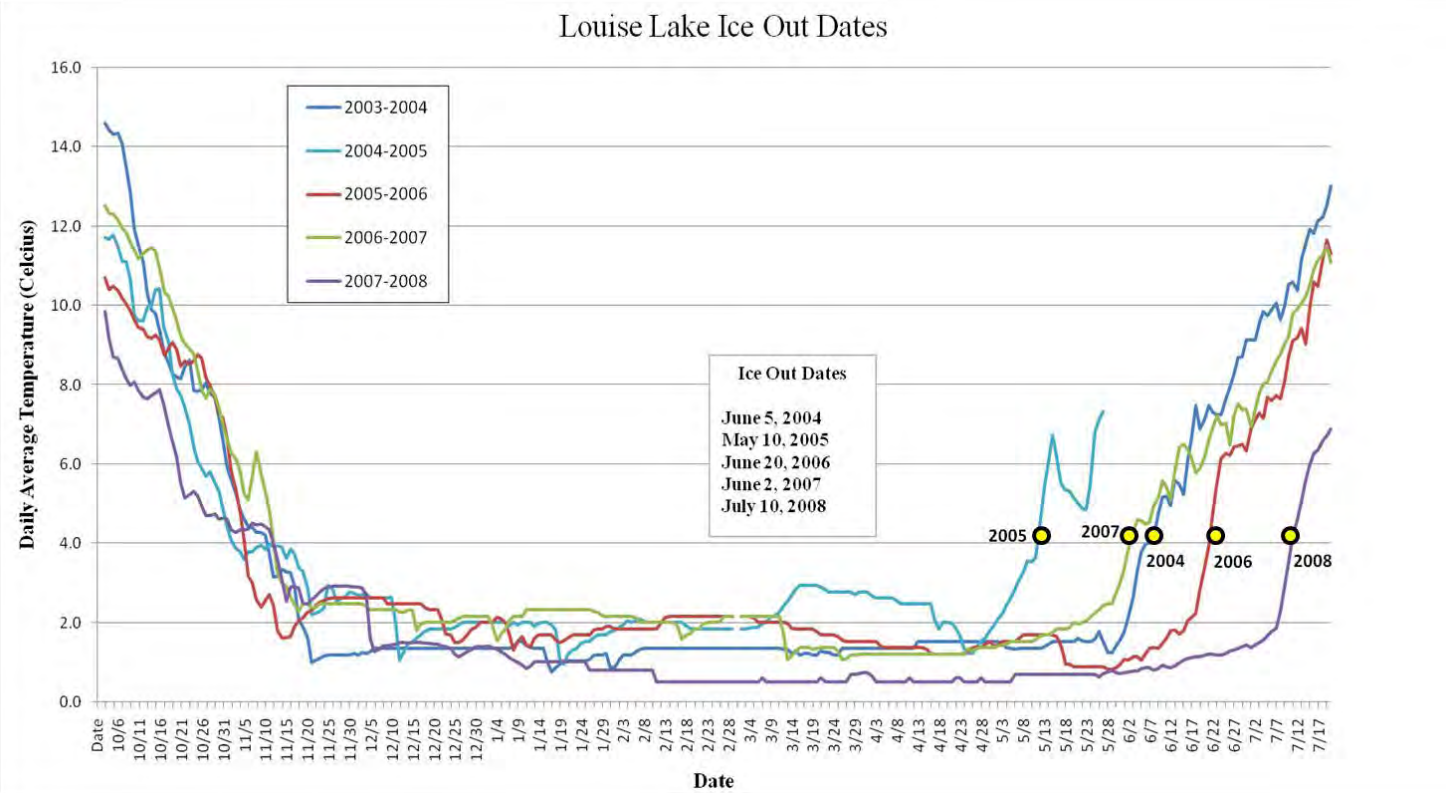
Status and Trends

The story of 2008 was an unusually cold winter, spring and summer created by La Niña conditions in the Pacific Ocean. La Niña is an extreme phase of a naturally occurring climate cycle referred to as the El Niño/Southern Oscillation. La Niña's occur every few years and typically result in cooler and wetter conditions in the Pacific Northwest.

Lower elevation sites at NCCN parks were blanketed in snow for much of the winter and spring. At Longmire in Mount Rainier National Park 307 inches (over 25 feet!) of snow fell. Average snowfall here over the last 75 years has been 165 inches. Conditions were much the same at Olympic National Park. In late March, snow still blanketed the river bottoms of the temperate rainforest and little or no "green up" or "leafing out" of deciduous trees had occurred, altering the spring feeding behavior of elk herds tallied in an annual census (see page 20).

The cold temperatures in the spring and early summer preserved snowpacks in the upper reaches of NCCN parks and hindered the melt-out of mountain lakes. Lake Louise and Hoh Lake, mountain lake study sites at Mt. Rainier and Olympic National Parks thawed out nearly a month later than normal and the latest in five years of study.

In fall 2008, the National Park Service and Natural Resources Conservation Service (NRCS) worked cooperatively to install two telemetered high elevation climate stations within North Cascades National Park. A basic weather station was installed near Noisy Glacier (6590 ft) and the existing Easy Pass snow-course site (5270 ft) was improved to a snow telemetry station. These sites provide near real-time data on air temperature, precipitation, snow depth, snow water equivalent, net solar radiation, wind speed and direction, and relative humidity.



Discussion

The severe weather events witnessed over the last few years could become more commonplace in the future. Climate scientists have documented an increase in the frequency and intensity of extreme winter time cyclones in the North Pacific over the last 50 years and models suggest that this could continue with global warming. Models also predict that there will be a large increase in the frequency of extreme precipitation events in the Pacific Northwest.

A December 2007 rainfall event provided an excellent opportunity to understand the benefits of having a relatively dense network of climate instruments in areas of climate complexity. During this event, a National Weather Service station near the Lake Quinault (OLYM) park boundary recorded 9.9 inches of rainfall. National Park Service instruments only 10 miles away but closer to constricted valley bottoms recorded 17.5 inches. This second measurement was much more consistent with flooding and debris flow damage witnessed after the event.

The cold winter of 2008, is an excellent example of the climate variability experienced by NCCN parks. These conditions, while unusual, were typical of those years when La Niña conditions affect Pacific Northwest weather patterns.

Contact: Bill_Baccus@nps.gov

Opposite South Fork Hoh River (OLYM) during spring elk survey, March 21, 2008. NPS/Baccus.

Above Previous five years of ice out dates on Lake Louise. NPS/OLYM

Glaciers

North Cascades, Mount Rainier

I & M RESOURCE BRIEF

Importance

Since the last ice-age, glaciers have continued to shape the dramatic scenery, topography, soils, lakes, streams, and landforms of the Pacific Northwest mountains. Covering a combined area of 235 km^2 in three large parks in the North Coast and Cascades Inventory and Monitoring Network, they are integral components of the region's hydrologic, ecologic, and geologic systems.

Each summer glaciers provide billions of gallons of freshwater for drinking, irrigation, hydroelectricity, fishing, water-based recreation, and wildlife. Glacial melt water comes at a critical time of year when the weather is relatively hot and dry, providing late-season recharge to the region's lakes and streams. On the Skagit river alone glaciers provide 8-12% of total summer runoff, or about 120-180 billion gallons.

The sensitive and dynamic response of glaciers to variations in both temperature and precipitation in all seasons makes them excellent indicators of regional and global climate change.

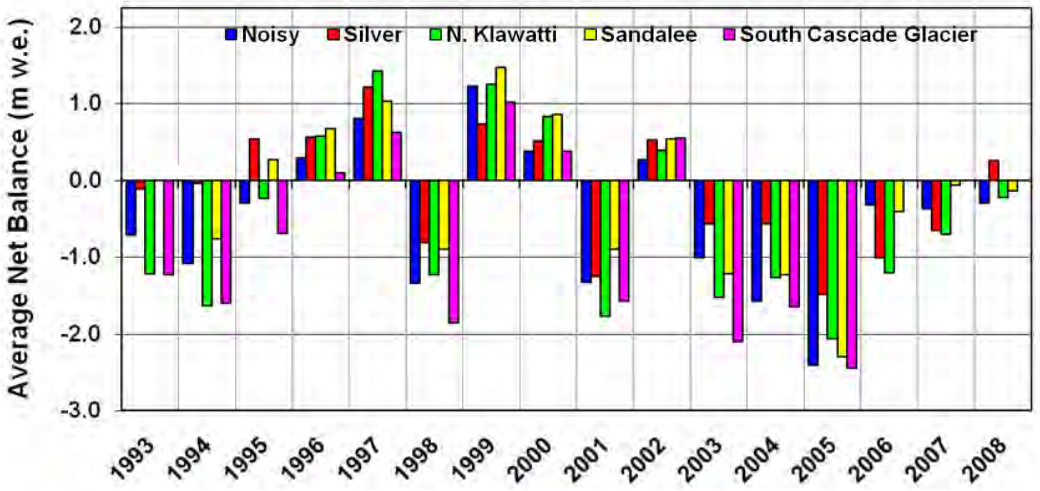
Status and Trends

Continued glacier retreat was observed throughout most of the Pacific Northwest between 2006 and 2008. Four glaciers monitored at North Cascades National Park (NOCA) lost 4.4 million cubic meters water equivalent and two glaciers monitored at Mount Rainier National Park lost 45 million cubic meters water equivalent during this period. This is a continuation of long term glacial retreat; NOCA glaciers have retreated an estimated 50 percent in the last 100 years. The buffering effects of glacier melt water during seasonal summer droughts is important to endangered salmon species, aquatic ecosystems and hydroelectric utilities. Between 2006 and 2008, glacial contribution to four watersheds within NOCA is estimated at 1.2 billion cubic meters. In Thunder Creek watershed, glaciers contribute as much as 48 percent of total summer flow. For more information see the North Cascades Glacier Monitoring Program website (http://www.nps.gov/noca/naturescience/glacial-mass-balance1.htm).

Discussion

Rapid loss of glaciers in this network is unambiguous evidence of global warming and reflects a pattern observed in mountain ranges around the world. Loss of this resource and the buffering it provides to aquatic ecosystems will complicate efforts to protect threatened and endangered aquatic species such as Chinook salmon and bull trout. Research using glacier monitoring data indicates that the loss of glaciers during the last century in Thunder Creek watershed at NOCA has resulted in a 25% decline in summer stream flow. Complete loss of the glaciers in this basin would reduce summer stream flow an additional 20%.

Contact: Jon_Riedel@nps.gov



Top Silver Glacier, North Cascades National Park in 1958 (Post) and 2006 (Scurlock). A map made in 1913 shows Silver Glacier completely covering Silver Lake.

Above Annual net mass balance of glaciers monitored at North Cascades National Park. Total net loss over this period for the four glaciers is 4.84 billion gallons. NPS/NOCA

Intertidal

Lewis and Clark, Olympic, San Juan Island

I & M RESOURCE BRIEF

Importance

The North Coast and Cascades Network (NCCN) of parks provides refuge for a vast reservoir of marine resources in the intertidal zone, an area inundated and exposed twice daily by the tide. The hallmark of NCCN intertidal areas is diversity. These parks contain a range of intertidal habitats, including rocky shorelines, cobble and fine sandy beaches, and mud flats. These habitats in turn support the highest diversity of intertidal invertebrates and seaweeds found along the entire west coast of North America.

The intertidal zone represents a transition zone between terrestrial and marine environments. Intertidal and nearshore marine ecosystems are tightly linked via nutrient cycling, dispersal of organisms between zones, and the opportunistic use of intertidal areas by nearshore organisms when they are flooded. The nearshore waters of the Pacific Northwest are extremely productive. Oceanographic processes, such as upwelling of deep nutrient-rich water on the open coast and complex tidal currents in Puget Sound profoundly influence the productivity and diversity of the intertidal zone. Most intertidal invertebrates and seaweeds have lifestages that live and disperse through the nearshore coastal ocean and contribute to its high productivity.

Intertidal organisms have evolved myriad adaptations to life in a harsh waveswept environment, yet these organisms are vulnerable to a wide range of anthropogenic stressors, including oil spills, invasive species, and global climate change. Climate change can affect intertidal organisms in a variety of ways, including exposure to increased water and air temperature, changes in sea level, increases in the frequency and magnitude of storm events, and increased acidity of the ocean caused by elevated CO_2 levels.

Status and Trends

The intertidal habitats of the NCCN parks are dominated by rocky platforms and sand beaches. Over 350 invertebrate and seaweed species have been documented from these areas. Intertidal fish inventories have documented over 70 species from NCCN parks. The NCCN Intertidal Monitoring program focuses on detecting long-term trends in the community structure of rocky intertidal and sand beach communities. Intertidal monitoring documents the abundance and number of each species present in plots. Because water temperature is a key determinant of intertidal community structure the monitoring also includes an array of temperature data loggers deployed along the shore.

As of the summer of 2008, 11 rocky intertidal sites have been established in the NCCN parks, along with eight sandy beach sites and 13 temperature monitoring stations.

Opposite page, left Steven Fradkin tallies intertidal organisms near American Camp, San Juan Island National Historical Park. NPS/Baccus

Opposite page, right Rocky headland at Goodman Creek, Olympic National Park. NPS/Baccus

Discussion

Intertidal monitoring in the NCCN complements other intertidal monitoring programs, including other NPS networks on the west coast. The core rocky intertidal monitoring follows the MARINe (Multi-agency Rocky Intertidal Network) protocol currently being implemented at Cabrillo National Monument, Channel Islands National Park, Redwoods National and State Parks, and a variety of other non-NPS sites along the west coast. Inclusion of this methodology in the NCCN parks allows for comparison of coastwide trends in the abundance of rocky intertidal organisms.

Intertidal monitoring in the NCCN will allow park managers to better understand the impacts of global climate change, and will provide parks with crucial baseline data needed for the assessment of impacts and recovery from catastrophic oil spills. All of the NCCN parks are situated along major travel routes for commercial shipping traffic, including oil tankers, bound for the ports of Vancouver (Canada), Seattle, and Portland. The Olympic coast has already experienced two major oil spills prior to the establishment of intertidal monitoring in 1988 (Nestucca) and 1991 (Tenyo Maru).

Contact: Steven_Fradkin@nps.gov

Landbirds

Lewis and Clark, Mount Rainier, North Cascades, Olympic, San Juan Island

I & M RESOURCE BRIEF

Importance

Landbirds are vital to every Northwest ecosystem. They are critical components in a complex food web, eating millions of seeds and insects and in turn, providing food for other creatures. Because they have specific requirements for food, nest sites, and habitats, they respond to subtle changes to their environment. For these reasons, birds are among the most sensitive indicators of ecosystem health and monitoring them is one of the most efficient ways to take the ecological pulse of an area. Bird populations are widely used as indicators of ecosystem health, and monitoring methods have been standardized, giving scientists a relatively low cost and statistically rigorous monitoring tool. Whether year-long residents or spring and fall migrants, birds bring color and song to our national parks. They have high and growing public interest and are the most visible faunal component of many park ecosystems. This broad public interest in birds ensures that landbird information gathered over time will be relevant to the public and to resource managers.

Despite many international treaties, domestic laws, and initiatives protecting resident and migratory bird species, landbird populations continue to decline. Because national parks provide relatively stable and protected habitat for birds, parks are among the few remaining places to study regional and global effects on bird populations. North Coast and Cascade Network (NCCN) parks represent excellent reference sites for comparison with more heavily impacted lands. And, monitoring landbird populations in Pacific Northwest national parks fills gaps in other regional monitoring programs, for example, collecting information in high elevation subalpine habitats which are virtually unmonitored by other programs.

Trends

The NCCN Landbird Monitoring Program completed its second year of long-term landbird monitoring in 2008. During the first two years of sampling, 1,976 point counts were conducted, 18,550 individuals birds counted, and over 100 bird species documented. The six most commonly detected species in 2007-2008 were Pine Siskin, Dark-eyed Junco, Red Crossbill, Varied Thrush, Winter Wren, and Townsend's Warbler.

Discussion

In 2007, NPS biologists working with The Institute for Bird Populations and the U.S. Geological Survey established a Landbird Monitoring Protocol for national parks in the NCCN. The NCCN Landbird Monitoring Program has completed two successful years of sampling with the comprehensive, field-tested protocol.

Preliminary results indicate the monitoring program will provide a robust dataset for evaluating a five year trend analysis in 2011, and that the monitoring program is detecting substantial annual fluctuations in bird populations. These fluctuations, when analyzed in the context of annual weather variation and perhaps other factors, should yield interesting and useful findings about the drivers of population dynamics in birds of Pacific Northwest forests.

Contact: Robert_Kuntz@nps.gov

Above Male yellow warbler, *Dendroica petechia*. USFWS

Large Lakes

North Cascades, Olympic

I & M RESOURCE BRIEF

Importance

Large lowland lakes are vital features of national parks in the North Coast and Cascades Network (NCCN). These water bodies account for a large percentage of renewable freshwater in parks and serve as valued centers of ecological activity. Wildlife, waterfowl, and fish species rely on large lakes. Their aesthetic and natural characteristics make them popular visitor destinations and attract recreational activity.

Beneath the surface, large lakes reveal the impacts of global stressors and human use. Global climate change and air pollution from nearby urban areas and across the Pacific Ocean affect how these ecosystems function. Their accessibility and recreational use also expose large lakes to human impacts such as increases in nitrogen and phosphorus compounds, road and shoreline development, and fish harvests.

Lake studies have been important to scientists' knowledge of ecosystem function. Important discoveries on species diversity, role of food webs, impact of acidification, and nutrient enrichment have all come from studying lakes. Large lakes are model systems for tracking long-term ecological changes associated with anthropogenic influences. Long-term time series data collected from these systems grant valuable insights for assessing conditions and evaluating management options.

Status and Trends

There are five large lowland lakes in the NCCN: two in Olympic National Park, and three in North Cascades National Park. The NCCN monitoring protocol has been peer-reviewed and accepted as an official protocol. The protocol is designed to track long-term seasonal and annual trends in key physical, chemical, and biological water quality parameters in major parts (basins) of each large lake. Permanent sampling stations are established based on GPS locations and water column profiles of parameters are sampled on a monthly basis. The parameters include:

- Temperature, dissolved oxygen concentration, specific conductance, pH (all are required core NPS-Water Resource Division parameters)
- Alkalinity, ion concentration, dissolved organic carbon
- Water clarity, lake level
- Nutrients, including nitrogen and phosphorus
- Zooplankton biodiversity and chlorophyll-α concentration

Discussion

While the NCCN monitoring protocol for large lowland lakes was reviewed and accepted in 2008, it was developed primarily for implementation only in Lake Crescent at Olympic National Park due to competing monitoring priorities and fiscal limitations within the NCCN. Because of funding restrictions, quarterly sampling following standard operating procedures will continue using park base funding as long as possible. The large lowland lakes protocol is expected to be implemented at North Cascades National Park outside the auspices of the NCCN Inventory and Monitoring program using outside special project funding.

Contact: Steven_Fradkin@nps.gov

Opposite Steve Fradkin, OLYM, sampling the water column of Lake Crescent using a programmable multi-probe data sonde. NPS/OLYM

Above Lake Crescent, Olympic National Park. NPS/OLYM

Mountain Lakes

Mount Rainier, North Cascades, Olympic

I & M RESOURCE BRIEF

Importance: Petri Dishes of the Pacific Northwest

Shrouded by clouds, mist, and snow for much of the year, high mountain lakes are ideal locations to assess environmental change affecting the high country of the Pacific Northwest. Without roads, factories, or sewage treatment plants, one would expect these areas to be free of human impacts. But in fact, scientists have found that mountain lakes are sensitive places to study the effects of climate change, air pollution, and visitor impacts. Mountain lake ecosystems are relatively simple in part because they are melted out only a few months each year and also because relatively few organisms can tolerate the harsh stress imposed by these frigid environments. In practice these high mountain lakes are like Petri dishes, trapping whatever falls from the sky and where the plants and animals living in those lakes are our indicators of ecosystem health.

The North Coast and Cascades Network (NCCN) has over 1500 mountain lakes spanning a gradient of urban influence from the West Coast across Puget Sound and into Eastern Washington. This gradient allows us to compare parks that are closer to urban centers (North Cascades and Mount Rainier National Parks) with Olympic National Park whose weather comes mainly from the Pacific Ocean.

Status and Trends

Given their high elevation, mountain lakes are particularly susceptible to the effects of atmospheric pollution. Pollutants such as nitrogen, ammonium, sulfur, and various contaminants (e.g., mercury and semi-volatile organic pollutants) are deposited from air masses that originate from industrialized areas. North Cascades and Mount Rainier National Parks receive pollutants from the rapidly growing Puget Sound and Frasier Valley metropolitan areas, whereas Olympic National Park receives more dilute pollutants from trans-Pacific sources (Asia) and nearby shipping traffic. Fish stocking in all three parks has altered native lake food web structure and nutrient dynamics. Global climate change is predicted to impact mountain lakes systems in a variety of ways. Increased air and water temperature can change the timing and duration of ice cover. Since these systems are ice-free only a fraction of the year, change in ice cover will fundamentally alter foodweb interactions, species diversity, and nutrient dynamics. Increased temperatures may also change the timing and amount of glacial and snow melt-water inputs to lakes, causing changes to hydrologic regimes that affect nutrient concentrations and foodwebs. Amphibians are essential components of mountain lake foodwebs. Their abundance and diversity can be altered by the introduction of non-native predators and diseases. Several diseases affecting amphibians are thought to be influenced by global climate change and visitor impacts. Many network lakes have historically been stocked with non-native fish, fundamentally altering biological community structure and nutrient dynamics. The NCCN Inventory and Monitoring Program is determining the status of a set of six target lakes in each park and will identify long-term trends in water quality, biological indicators, and lake physical characteristics. These data will provide baseline data to predict future changes in these vital park ecosystems.

Opposite Hugh Anthony, aquatic ecologist, surveys Lower East Lake, North Cascades National Park. NPS/NOCA

Management Applications

This monitoring program will provide information to:

- Better understand impacts of atmospheric pollution
- Better understand impacts of global climate change
- Develop criteria for restoring lakes impacts by non-native species
- Identify impacts associated with backcountry visitation

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Elk

Lewis and Clark, Mount Rainier, Olympic

I & M RESOURCE BRIEF

Importance

With their large size and wide-ranging movements, elk play an influential role in Pacific Northwest ecosystems. From coastal sloughs and lowland rain forests up through subalpine meadows, these majestic herbivores affect plant growth and species composition, play a role in nutrient cycling, and are prey for predators such as bears and cougars. Outside park boundaries, elk viewing and hunting opportunities are valued recreational activities and are important for the regional economy.

Elk protection was a key reason for the establishment of Olympic National Park, and elk are important ecological and cultural components of other North Coast and Cascades Network (NCCN) parks. Biologists with NCCN and the U.S. Geological Survey are developing improved methodology for elk monitoring at Olympic National Park and Lewis and Clark National Historical Park. The NCCN and USGS are also working with the Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, and the Washington Department of Fish and Wildlife to increase the accuracy of surveys in subalpine habitats of Mount Rainier National Park.

Status and Trends

Biologists monitor elk populations using a variety of methods. On the ground at Lewis and Clark National Historical Park, NCCN and USGS biologists searched for elk fecal pellets in plots throughout the Fort Clatsop park unit in November 2008. Pellet counts provide an accurate index to population size. At Lewis and Clark National Historical Park, biologists also monitor elk populations by driving survey routes along park roads.

At the larger parks, biologists conduct aerial counts using helicopters. Even from this vantage, not all elk in a surveyed area can be detected. One goal in Olympic National Park and Mount Rainier National Park is to estimate how factors such as group size, and the amount and type of vegetation in which the group is located influence an elk group's 'sightability,' which is the probability of detecting an elk group that is in the surveyed area. Sightability can best be determined using radio-collared animals. If an animal is not seen during a survey, the radio-transmitter is used to find where it was when the survey occurred, and determine if the animal was missed, or if it was not in the surveyed area. Elk work in Olympic in 2009 focused on deploying radio collars for use in determining sightability. surveys in 2009 included one spring and two fall surveys at Olympic National Park, and five fall survey flights at Mount Rainier National Park.

Discussion

Because topography and vegetation reduce visibility of elk, estimating elk 'sightability' can only be conducted with radio-collared elk. In 2009 surveys at Mount Rainier National Park, biologists were able to track elk with radio collars supplied by the Muckleshoot Indian Tribe and Puyallup Tribe of Indians. During surveys this led to observations of 30 elk groups with at least one radio collar. At Olympic National Park, 31 elk that were fitted with radios in 2008 and 2009 will be available for sightability observations, which started in the spring 2009 surveys. GPS units on seven of the collars have been e-mailing four location points per day to NPS and USGS biologists, greatly increasing our understanding about movement patterns of this keystone species in the park ecosystem.

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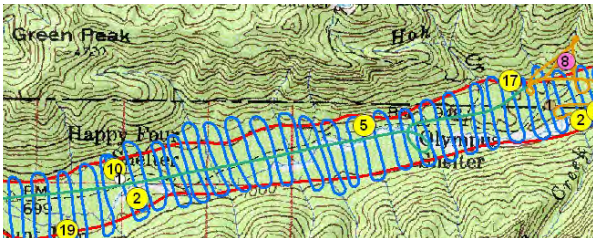
Opposite top, A herd of Roosevelt Elk, from an aerial survey, September 2008. Olympic, NPS/Happe

Opposite bottom Helicopter flight path (purple) of the March 22, 2008 elk survey crisscrossing the Queets river valley (OLYM). Where the elk groups were seen, yellow circles are labeled by group size.


Green Peak
Happy Four
Shelter
Olympus
Shelter
8
17
2
5
10
2
119

Fish Populations

Olympic

I & M RESOURCE BRIEF

Above A male and female pink salmon and juvenile rainbow trout observed during a snorkel survey in the Elwha River. John McMillan, NOAA Fisheries. Joe McMillan, NOAA Fisheries

Opposite Fisheries biologists conduct snorkel surveys in the South Fork Hoh River and seven other Olympic rivers on a weekly basis from June through September each year. Javin Elliff

Importance

North Coast and Cascades Network (NCCN) parks protect some of the best remaining Pacific salmon habitat outside of Alaska. The free-flowing and unregulated rivers and streams that originate in Olympic, Mount Rainier, and North Cascades National Parks comprise large tracts of contiguous, undisturbed aquatic habitat home to numerous species of native salmon.

Salmon are born in rivers, run to sea, and return to their native streams to spawn. Hence, salmon communities link freshwater, marine, and terrestrial ecosystems – making them excellent indicators of ecosystem health. Studies have shown that Pacific salmonids provide food for over 130 species of aquatic and terrestrial wildlife species and that 20–40% of the phosphorus, nitrogen, and carbon in freshwater systems derive from their carcasses.

Salmon are ecologically, economically, and culturally important to the Pacific Northwest and they contribute significantly to recreational, commercial, and tribal fisheries. But these native fish face several threats including overharvest, habitat degradation, and competition from hatchery and non-native fish. Despite the vital importance of native anadromous and resident fish populations, there has been no integrated monitoring program for fish assemblages in the NCCN.

Status and Trends

NCCN rivers support numerous fish species and unique populations of Pacific salmon, trout, and char. Fish species within Olympic National Park are now being monitored by snorkeling in eight rivers and electrofishing in five streams. These two complementary techniques will allow for adults to be monitored in rivers and juveniles in streams with the goal of determining seasonal and annual trends in:

- Fish species composition
- Fish growth
- Timing of migration
- Relative abundance
- Age and size structure
- Extent of non-native fish and hatchery salmonids
- Water temperature

Olympic National Park contains 31 native species of fish, six non-native species of fish, and at least 70 unique populations of Pacific salmonids throughout 12 major watersheds and 3,500 miles of flowing water.

Discussion

Extensive monitoring of native species by tribes and the State of Washington focuses on commercially and recreationally valuable species like coho, Chinook, and steelhead. The addition of this monitoring program designed by National Park Service and U.S. Geological Survey scientists will provide managers with valuable information for several fish species and important information for the protection of the last and best remaining habitats for Pacific salmon and other native fish communities. Specifically, this monitoring program will allow managers to detect trends in high priority management species, non-native and hatchery fish, and federally listed fish. It will also inform management actions pertaining to:

- Harvest management
- Generation of fishing regulations
- Hatchery supplementation
- Control of non-native fish species
- Habitat restoration projects

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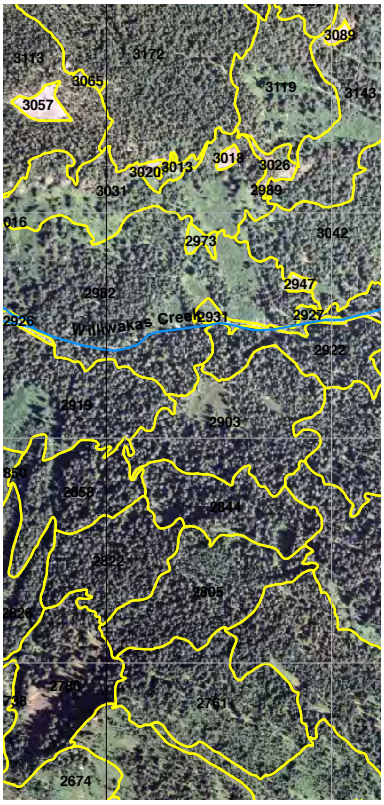
Vegetation Mapping

Olympic, Lewis and Clark,
Mount Rainier, San Juan Island

I & M RESOURCE BRIEF



Importance

The North Coast and Cascades Network (NCCN) is developing vegetation maps for Mount Rainier, Olympic, Lewis and Clark and San Juan National Parks. Conserving the biodiversity in the Parks requires knowledge of the variety and extent of plant species and communities. Exotic species, insect outbreaks and diseases present challenges to the resilience of our park ecosystems. To address these challenges, park managers rely on vegetation maps and inventories that help them evaluated changes in and better understand relationships between vegetation and wildlife, wildland fires and other managed resources. These new maps will aid park managers to document and preserve the diversity of all species, big and small, within the parks.

Vegetation Maps

The National Park Service mapping program has established a set of standards for mapping which dictate the scale, resolution, accuracy and vegetation classification scheme to be used. Basic steps for creating the Mount Rainier vegetation map:

1. Create polygons. Draw boundaries around distinct vegetation types seen in aerial photographs or satellite imagery.
2. Field sampling. Visit selected sites identified in the mapping process and assign a vegetation type using a field key.
3. Map classification. Classify all sites using computer program that assigns vegetation types to all defined areas that share similar characteristics to those sampled in the field.
4. Accuracy Assessment. Evaluate the accuracy of each mapped vegetation class using field data held in reserve.

How are vegetation types assigned?

The NPS adopted the National Vegetation Classification System (NVC), a hierarchical system that uses both structural and floristic information, to define existing vegetation types. There are eight levels in the NVC hierarchy. The topmost levels are general and separate vegetation types based primarily on structure, specifically whether they are dominated by trees, shrubs, or herbaceous plants. The middle levels of the NVC hierarchy incorporate biogeographic range, climate, substrate and dominant or diagnostic species. The NPS selected the second-finest level, called the Alliance level, of the hierarchy as the target for vegetation mapping. Map users will find the vegetation Alliances on the maps intuitive because the dominant canopy vegetation determines the Alliance. For example, the Western Hemlock-Douglas-Fir Mesic Forest Alliance is found extensively at lower elevations at Mount Rainier. At slightly higher elevations, the Silver Fir-Subalpine Fir Alliance predominates. The lush and iconic subalpine meadows at Mount Rainier are typically the Showy-sedge-Sitka Valerian Meadow Alliance. These are just three examples from over 50 alliances that occur at Mount Rainier.

Project Status

The vegetation mapping team created a draft map of vegetation polygons for Mount Rainier. During the summers of 2008 and 2009, NPS field crews sampled polygons in areas all over the park. In 2010 the cooperators will do a final computer classification and the final map will be available in 2011. The NPS field crew will be sampling at Olympic National Park during 2010 and 2011. Ongoing work at Lewis and Clark and San Juan Island National Parks is being done by cooperators with the Oregon and Washington Natural Heritage Programs.

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Opposite An example of the vegetation polygons created using automated computer analysis techniques. The area shown in this example is just upstream from Longmire where the Paradise Road crosses the Nisqually River. Polygons are outlined in yellow and numbered, roads are shown in black, and rivers and streams in blue. In the final map, vegetation polygons classified with the same vegetation type will be merged. NPS/MORA

Above NCCN Vegetation Mapping Crew lead Stacy McDonough annotates her field map while sampling subalpine plant communities at Mount Rainier.

Forest Vegetation

Lewis and Clark, Mount Rainier
North Cascades, Olympic,
San Juan Island

I & M
RESOURCE
BRIEF

Importance

Mature and old-growth forests are icons of the Pacific Northwest. In the parks of the North Coast and Cascades Network (NCCN) forests range from coastal rainforests with massive trees draped with mosses and ferns and surrounded by dense understories; to areas with drought-adapted Ponderosa pines; to high-elevation subalpine fir forests interspersed with meadows just below treeline. These forests, in turn, are the foundation for other biotic communities constituting Pacific Northwest ecosystems.

Climate change, air pollution, invasive species and other stressors threaten forest structure, species composition and abundance, thereby threatening the quality and quantity of habitat for terrestrial birds and wildlife. In particular, climate change and air pollution are expected to be the greatest threats to national parks in the Pacific Northwest. Changes in forest structure and composition will also alter the chemistry of water moving from terrestrial to aquatic systems. Consequently, forest monitoring is a fundamental part of the overall monitoring plan for the parks of NCCN. Tree recruitment, growth, and mortality are sensitive indicators of ecological change that can only be documented and understood through detailed, long-term observations. Increases in tree mortality have recently been reported for western North America, demonstrating the utility of long-term forest monitoring.

Status and Trends

The NCCN monitoring program has established 35, 1-hectare plots at Mount Rainier, North Cascades, and Olympic, at elevations from sea-level to 1800 meters. Plots established to date include 21 tree species, representing most of the diversity of species in the parks. Additional plots will be established at San Juan Island and Lewis & Clark in the next few years. The specific forest types selected capture the extremes and the middle of the temperature and precipitation gradients for forests in the network. Sitka spruce forests at Olympic and Lewis & Clark comprise the warm and wet end of the gradient. These forests are important winter feeding grounds for Roosevelt Elk. The cold and dry end of the gradient consists of subalpine fir forests at North Cascades and Mount Rainier. The middle of the gradient is represented by western hemlock with a salal and/or Oregon grape understory, measured at Mount Rainier, North Cascades, and Olympic. These forest types are common throughout the region and monitoring results will provide benchmark information for managed forests. Target vegetation communities for San Juan Island have not yet been identified.

Tree mortality will be assessed annually and tree recruitment and growth will be recorded every five years. Trends in tree mortality will be reported every year, starting in the fourth year (2011). Trends in tree recruitment and growth will be reported after 15 years and trends in stem densities and tree basal area will be reported after 10 years.

Opposite Olympic National Park employee Patrick Loafman measuring a Douglas-fir tree at a long-term monitoring plot in the Elwha watershed, Olympic National Park. NPS/OLYM

Discussion

A recent report in the journal *Science* estimated that in recent decades the rate of tree mortality in old-growth forests in the Pacific Northwest has doubled every 17 years, probably due to regional warming and consequent stress caused by drought. This could lead to fewer large trees, less carbon storage, and forests predisposed to abrupt dieback. Forest monitoring in the NCCN will determine whether or not the recently-observed trend in tree mortality is continuing. It will also provide information about:

- changes from historic conditions
- type of habitat the forests provide for other plants and animals
- the forest's ability to capture CO_2
- susceptibility to pests and pathogens

This and other information will assist managers in protecting the forests and related park ecosystems.

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Whitebark Pine

Mount Rainier, North Cascades

I & M RESOURCE BRIEF

Importance

Whitebark pine (*Pinus albicaulis*) is an integral component of high-elevation ecosystems in Western North America. It is often the first tree species to establish in subalpine meadows or on alpine ridges. Once present on a site, whitebark pine influences snowmelt patterns, soil development, and provides important micro-sites for the establishment of other subalpine plant species.

Whitebark pine seeds are a valuable food source for birds, squirrels, and bears. Clark's nutcrackers (*Nucifraga columbiana*) and squirrels (*Tamiasciurus spp.*) extract seeds from the closed cones and then cache them in subalpine meadows for future retrieval.

White pine blister rust (*Cronartium ribicola*), a non-native fungus, and native Mountain pine beetles (*Denderoctonus sp.*) threaten the long-term survival of whitebark pine populations in the Pacific Northwest.

Status and Trends

Whitebark pine grows on cold, dry sites generally above 5,000' (1524 m) and can be found in three national parks within the North Coast and Cascades Network (NCCN). In Olympic National Park, whitebark pine is limited to three populations east of Mount Olympus, and trees are often found in a clumped formation where individuals are difficult to distinguish. In North Cascades and Mount Rainier National Parks, whitebark pines are generally distinct individuals in the subalpine zone or krummholz (short, shrubby growth form) near treeline. They occur predominately on the east side of North Cascades National Park and the northeast corner of Mount Rainier National Park, although smaller disjunct populations are found on the west side of both parks.

Discussion

Monitoring plots were established in Mount Rainier and North Cascades National Parks in 2004 to document trends in rates of infection and mortality. These plots will be monitored in 2010 to determine if the status of whitebark pine stands has changed since the initial surveys.

Research is also being conducted to determine patterns of genetic diversity, genetic resistance to blister rust, and methods to restore whitebark pine populations. In 2007, initial results of the genetic resistance screening indicated that seedlings grown from Mount Rainier parent trees have the highest levels of rust resistance of any seed source in the Pacific Northwest, as tested by the US Forest Service. Results of research and monitoring will be utilized to develop site specific restoration strategies.

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Left White pine blister rust enters the tree through the needles and then travels down to the branches. As the fungus fruits, cankers develop causing the stem to swell and the bark to become rough and broken. NPS

Right Dead whitebark pine among subalpine fir in North Cascades National Park. NPS

Cultural Landscapes

EBEY'S LANDING NATIONAL HISTORIC RESERVE

Importance

Ebey's Landing National Historical Reserve, on Whidbey Island, Washington State provides the nation a vivid and continuous record of Pacific Northwest history. The land appears much as it did a century ago. Patterns of settlement, historic homes, pastoral farmsteads and commercial buildings are still within their original farm, forest, and marine settings. A visitor can experience a variety of diverse physical and visual landscapes within a small geographic area. The community of Ebey's Reserve is a healthy, vital one that allows for growth and change while respecting and preserving its heritage.

The cultural landscape of the reserve is made of historic settlement, development patterns, and natural features. Collectively, landscape patterns and their relationship over time imprint and reflect human history in the land and give it its unique Northwest character. A few examples of the unique attributes of this place include:

- Unique geography of naturally formed prairies, surrounded by wooded ridges, and shorelines.
- How settlers responded to the natural environment in their development, farming and homestead choice
- Vegetation related to land use such as the formation of hedgerows in historic farm boundaries
- Road systems charting the paths of wagon roads, and bearing the names of early and present day farm families
- Cluster arrangement within farms, representing the periods of farm use and technology over the past 150 years.
- Archaeological resources including over 40 seasonal and permanent camps of Native Americans.
- Views and other perceptual qualities where one can imagine what it was like to be here hundreds, if not thousands of years ago.

Current Status

While the landscape of Ebey's Landing still retains its stunning beauty, agricultural character and historic integrity, current patterns of growth show that impacts of urbanization are changing the landscape. Whereas many national park units have a distinct boundary between park and surrounding communities, the Reserve differs in that most of the land it has been charged to protect is also owned by private citizens. Of the Reserve's 17,572 acres, by design 90% is privately owned as well as 98% of the 400 historic structures on the National Historic Registry.

Above Jacob Ebey House, 1855. An NPS property under restoration as an adaptive re-use Visitor Contact Station. NPS/EBLA

Opposite Ebey's Prairie overlooking soils of national significance, Mt. Baker in the background. NPS/EBLA

The pressures facing the Reserve are more complex now than 31 years ago and require a more collaborative approach to implementing systems to protect the significant historic structures and landscape of the Reserve. A legal process called "Design Review" for homeowners and builders would provide standards in development, construction, and repairs to ensure the cultural landscape retains its rural character and integrity for generations to come. Historically, citizens have used two different design processes in the Reserve for new development: the Town of Coupeville's Design Review Board, which acts as a regulatory body, and the Island County's Historic Review Committee, which is an advisory board.

With the Town of Coupeville's leadership, these two partners are now working together to develop a consolidated and comprehensive approach to design review. The partners are committed to establishing a cultural landscape approach to design review, understanding the connectivity of the Reserve's resources, and the importance of leveraging partnerships in managing the nation's historic reserve. In the coming months, a single Historic Review Committee will be formed by the partners, and will be trained by the Trust Board.

Discussion

While conservation easements to prevent future development are the highest priority and most effective way of protecting cultural landscapes, it is also important for citizens to have their own tools available. Many citizens, especially those who have recently moved into the community are unaware that they live within or near a protected historic reserve. The following are tangible actions to help empower private property owners to value and protect Ebey's Landing:

- Publication of a Design Review Manual that illustrates and features visual examples of appropriate building, remodeling and preservation techniques to retain historic character.
- Creation of an annual Ebey's Forever Conference in November, featuring leading local, regional, and national voices in cultural resource management, sustainable agriculture, and interpretation.
- Establishment of an annual Reserve "Barn Raising" Preservation Field School, featuring four-week hands-on restoration work on a historic structure in the Reserve.
- Established Ebey's Forever Fund in November 2009 to provide owners of historic structures with funding for preservation and easements on completed projects.
- Develop Design Review workshops for owners of historic properties, builders, realtors, and other stakeholders to understand regulations.
- Develop an annual training program for new review committee, partners, and staff.

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Hudson's Bay Company's Village

FORT VANCOUVER NATIONAL HISTORIC SITE

Importance

The Hudson's Bay Company's (HBC) Village at Fort Vancouver was the most ethnically diverse settlement on the Pacific Coast in the early-19th century, and was the largest European colonial settlement between Mexican/Spanish California and Russian Alaska until ca. 1845. The HBC Village was home to people of French-Canadian, Scottish, English, American (including African American), Portuguese, Hawaiian, and Native American ancestries, including Iroquois, Cree, Métis, and many of the indigenous peoples of the Pacific Northwest. The Village employees supported Fort Vancouver from 1825-1860. The Village, which is physically separated from the Fort Vancouver stockade complex, contained over 60 residential structures, with peak population at between 600-1000 people. By the 1850s, a substantial Native Hawaiian population was present, leading it to be called "Kanaka Village" (Hawaiian word for "person") by American immigrants.

The diversity of the Village population makes it an ideal place to examine identity and ethnicity in a colonial/frontier setting. Given that much of the archival records of the village were written by the elite company managers and clerks and the few literate visitors to the fort, the well-preserved archaeological remains of the Village make Fort Vancouver an excellent "living laboratory" to explore the worker's identity and lives. Compared with the scant archival data, the site contains an abundant archeological record. Historical archaeology is using these data to restore the history of the diverse peoples that met, mingled and created families in the Pacific Northwest's colonial period.

Left Jacqueline Cheung, FOVA archeological technician, conducts a magnetometry survey in the HBC Village, April 2009. NPS/FOVA

Right The reconstructed HBC Village houses, a view from the Landbridge. NPS/FOVA

Status

Much of the archaeological remains of the village have been lost to development by the U.S. Army and the construction of major transportation infrastructure including the Burlington Northern Santa Fe Railroad, Washington State Route 14 and Interstate 5. The last 10 years have seen a movement to restore portions of the village and to protect those areas that remain. Multidisciplinary archaeological research, utilizing GIS-based analysis, remote sensing surveys, and traditional historical archaeological techniques has lead to the restoration of the fenced eastern boundaries of the village, reconstruction of two of the Village houses, the restoration of other landscape features, including fences and paths around these structures, and protection of the Old Apple Tree, which dates to ca. 1827, and graced the yard of a village house.

A new pedestrian overpass, the Confluence Project Land Bridge, was added to the HBC Village area in 2008 as part of the Lewis & Clark bicentennial. The Land Bridge reconnects the HBC Village and the Fort with the Columbia River, and walking paths invite visitors to visit the HBC Village on a daily basis. The Land Bridge also helps to interpret archaeological data and defines features of the historical landscape that were lost to encroachment by 20th century highways and railroads. Research on the HBC Village continues to develop, and another season of excavation is planned for the summer of 2010. Threats to the resource include encroachment on the landscape and archaeological resources by the proposed Columbia River Crossing I-5 Bridge project. Development of a Visitor Experience Resource Protection (VERP) monitoring program for the Village is underway and will guide how cultural resources protection specialists can address the new visitor impacts to the resource associated with the establishment of interpretive features.

Discussion

The HBC Village preserves the unwritten history of the most diverse Euro-American settlement in this region of the early to mid 19th century. Systematic, scientific archaeological surveys and testing operations conducted in the last ten years show that the HBC Village contains numerous untapped resources, and the research potential to reveal new insights into such varied topics as gender and class differentiation, ethnicity and the expression of identity, culture contact and many other subjects. Nuanced studies based in historical archaeological theory can tell us more about the people of the HBC Village and how they lived and worked together. The work will assist the Park Service to bring these histories to the attention of underserved populations and provide opportunities to enlighten these populations on the importance of science in understanding the past. The site is protected under the Archaeological Resources Protection act and Washington State Law.

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Hilscher Collection

KLONDIKE GOLDRUSH NATIONAL HISTORICAL PARK - SEATTLE

Importance

Klondike Gold Rush National Historical Park (KLSE) is a National Park area that relates the human drama of the Klondike Gold Rush when 100,000 people worldwide were enticed to leave their homes and endure extreme hardship traveling to the remote and often frozen Canadian Yukon to find gold. Seattle became a major Northwest coastal city because it was the supply depot for thousands of gold rushers who departed on vessels with provisions to last a year. Since 2006 KLSE has been based in Seattle's Pioneer Square National Historic District in the 1889 Cadillac Hotel. Displays highlight the 1897-1899 Klondike Gold Rush history through interpretive exhibits, historical replications, and artifacts.

In 2008, a significant donation of 100 year old artifacts was made to the park by Hilary Hilscher, Granddaughter of Seattle-ite and 1897 Klondike Gold Rusher John Fredrick Hielscher. Ms. Hilscher donated a steamer trunk containing a treasure trove of archival material including correspondence, legal and financial papers, bundled and loose papers and manuscripts, photographic prints and journals documenting Hielscher's 17 years of adventure in Alaska and the Yukon. The trunk and its contents represent one of the most significant collections ever received by the Seattle Unit of the Klondike Gold Rush National Historical Park revealing an extensive and intimate family gold rush history.

Status

The Hilscher Collection is now receiving careful curatorial and archival treatment from NPS staff. The historic paper artifacts are sensitive to external conditions such as visible and ultra-violet light exposure, fluctuations in relative humidity and temperature, air pollution, pest infestation, careless handling, and improper storage.

The Hilscher document collection was made out of groundwood pulp, was rolled and stored in the wooden steamer trunk for close to a century, and has ink as its media. The ink is possibly iron gall ink which causes discoloration of the ink over time and breakdown of the paper fibers resulting in holes in the paper and the loss of complete sections of the written information. Paper invented in China over 2000 years ago was made by hand from plant fibers and was scarce and very expensive. In the mid-19th Century, paper was more accessible and inexpensive during the Industrial Revolution but was manufactured using groundwood pulp (lumber), instead of, or in combination with plant fiber. Bleaching agents, sizing, media (inks, pigments, etc.) were added making the paper chemically unstable and susceptible to change from handling, storage, the environment, and resulting deterioration.

The Hilscher Collection 1889-1943 (bulk dates:1898-1914) has been archivally processed, but needs to undergo a conservation assessment conducted by a professional paper conservator to determine its current condition, any environmental influences that might be affecting the deterioration rate of the paper, if conservation treatment should be performed, and whether or not stabilization treatment is needed. The assessment will determine how and under what conditions the collection should be stored and whether or not the collection is stable enough to provide access through research, exhibiting, and digitizing.

Discussion

Historic documents, correspondence, and artifacts saved by Klondike Gold Rushers, passed down through families, and donated to the park illuminate each gold rusher's events and experiences. These documents give us insight into each one's perception; their tragic or successful accounts conveying the full spectrum of human drama in this historic event. Often, additional details answer historic questions raised in previous accounts by other gold rushers. The value of donations of the magnitude of the Hilscher Collection cannot be overstated. Who knows whether additional hidden treasures will be discovered? With passing time these original documents become rarer and more precious as they are the true connection between the park and the past it was created to document. These treasures allow us to convey the gold rush experience so that visitors can gain insight into the gold rushers' motivations, hardships, and personal accomplishments as gold miners, entrepreneurs, and pioneers.

Estuarine Restoration

LEWIS AND CLARK NATIONAL HISTORICAL PARK

Importance

The Columbia River Estuary is home to some of the most historically abundant salmon runs in the world. In the last century these runs have suffered precipitous declines due to numerous stressors including overfishing, dam building, and habitat conversion. Today, restoring these runs has become an economic, cultural, and ecological priority for the region.

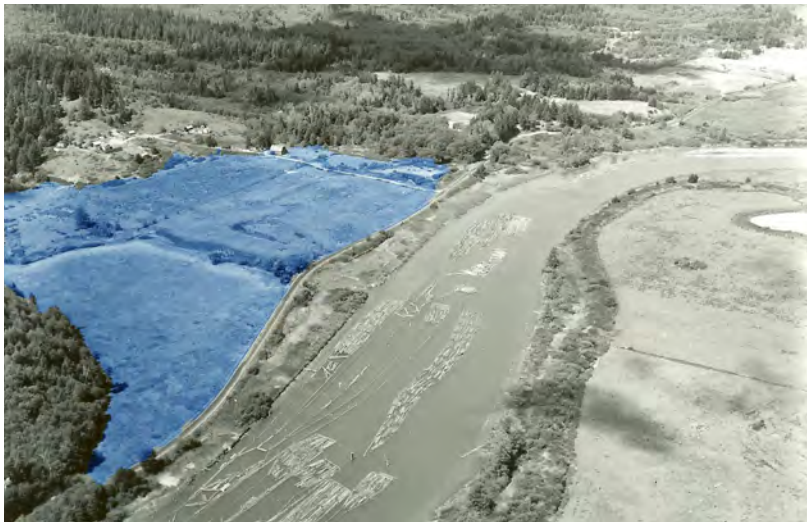
Lewis and Clark National Historical Park is part of the Youngs Bay watershed which empties into the Columbia estuary near Astoria, Oregon. Estuarine and connected wetland areas within the Youngs Bay watershed provide critical habitat for numerous species, including threatened and endangered young salmon that rear and seek refuge from winter storms in these relatively sheltered environments. Unfortunately, these tidal and estuarine wetlands are among the most severely impacted habitats in the watershed: dikes and drainage ditches for agriculture have destroyed an estimated 95% of former wetlands within the area. The majority of the Youngs Bay estuary and wetland habitats have been diked and drained for pasture and agriculture.

Restoration of wetlands and estuarine habitat within the park's boundaries is part of an approved Estuary Partnership Management Plan, and will contribute to the plan's goal of restoring 16,000 acres of wetland habitat throughout the watershed. Together with numerous partners and stakeholders working on similar projects, the estuarine restoration projects at LEWI will contribute to the recovery of historic salmon populations, and the overall ecological integrity of the lower Columbia River Estuary.

Left A dike and five foot wide tidegates (LEWI) kept the historic marsh from being replenished by the tide.

Right Same camera angle. Workers widen the flow to bring more nutrient waters back into the slough.

Opposite Project area, in blue, showing the 50-acre former pasture that is now a reconnected tidal floodplain. Summer stream flow an additional 20%.



Restoring the South Clatsop Slough

In 2006, Lewis and Clark National Historical Park acquired 50 acres of tidal marsh which had been diked and converted to pastureland when it was homesteaded in the 1800's. Through partnerships with the Columbia River Estuary Study Taskforce (CREST), Bonneville Power Administration (BPA), National Oceanic and Atmospheric Administration (NOAA), Lower Columbia River Estuary Partnership (LCREP), and the U.S. Fish and Wildlife Service (USFWS), Lewis and Clark secured funding to remove an existing tidegate and replace it with a 46' span bridge in the summer of 2007. This action allowed the Lewis and Clark River to begin to re-inundate its historic floodplain.

With the help of our partners at CREST, we have been monitoring changes in vegetation communities, fish assemblages, water quality, and macro-invertebrate abundance and diversity at what has become known as the South Clatsop Slough Restoration Site. So far, the results have been very encouraging. Almost immediately, we found juvenile coho, Chinook, and chum salmon utilizing the newly available off-channel habitat. Finding chum is particularly exciting, as this species was thought to have been extirpated from the Lewis and Clark River.

In addition to increased foraging and refuge opportunities for salmonids, South Clatsop Slough is also now supporting a multitude of native wildlife, including migrating waterfowl and rich insect assemblages. Plantings of native plant species such as wapato (*Sagittaria latifolia*) and crabapple (*Malus fusca*) by local school children have been successful and will continue to add to the biological diversity of the site.

Discussion

The work at South Clatsop Slough is just the beginning of Lewis and Clark's active involvement in the restoration of tidal communities in the lower Columbia River estuary. We will continue to monitor the site and work closely with our partners, and we are currently in the design phase of a complementary 35 acre restoration project at Otter Point, about ½ mile downriver. Our partnerships and community support have been critical to what we have accomplished, and we will continue to foster these relationships to work towards the common goal of a healthy, resilient, productive watershed.

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Stream Aggradation

MOUNT RAINIER NATIONAL PARK

Top The aftermath of a debris flow at MORA, NPS.

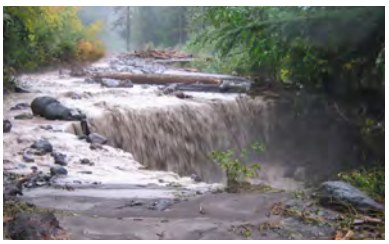
Opposite A flood in September 2005 spills across a road at Mount Rainier, NPS.

Importance

Mount Rainier is an active volcano considered the most dangerous US mountain because of its proximity to major cities. However, it is the more "everyday" risks such as floods, debris flows, and river aggradation (or filling) that are posing unprecedented challenges to public safety at Mount Rainier National Park and to its infrastructure.

Because of vast amounts of sediment sloughing off the mountain, Mount Rainier's rivers are aggrading that is, the river beds, on average, are rising by natural processes. Recent aggradation has more than doubled in the last 10 years (to over three feet per decade). This means that for the same size storms, the flood potential is ever increasing, since the "capacity" of the river channel is reduced, as the channels fill in.

This problem is further compounded by debris flows. Debris flows are destructive, sediment-laden slurries that move downhill by gravity. In areas affected by debris flows, large rivers near developed areas have aggraded an astounding 38 feet since 1910, and almost six feet in a single year. The park has had at least 16 debris flows since 2001, and there were multiple debris flows in three streams that had not had debris flows in hundreds of years. In 2006, there were 10 debris flows in two days, resulting in extensive damage to park roads and campgrounds, and closing the Park for six months. Specialists predict further increases, as glaciers continue their rapid retreat due to global warming, making this a major management concern at Mount Rainier National Park.



Status and Trends

Most recent debris flows occurred during warm, "pineapple express" storms blown in from the Pacific ocean, the number and intensity of which have increased measurably. Floods on the Nisqually river that used to occur only once every hundred years on average (a 100 year recurrence interval) now have a recurrence interval of only 14 years!

In several parts of the park, the roads are lower than the adjacent river. For example, State Route 410 is 16 feet below the river. Even at summer flows, the water is higher than the road. During floods, the rivers spill onto the roads, causing major damage. Recent floods have also decimated the park's Westside and Carbon river roads.

To help understand the severity of the hazard, NPS has on-going studies looking at:

1) *Aggradation*: Annual and post-flood resurveying of established river cross sections;
2) *Debris flows*: On-going collaborative effort with Oregon State University to understand the debris flow initiation mechanisms and future frequencies;
3) *Glacier mapping*: Used for hazard analysis to identify stagnant ice (which spawns glacier outburst floods); and
4) *Pre-disaster planning*: To identify and prioritize road segments prone to flood damage in the park and to develop a suite of options to protect these areas in a fish-friendly way. The information is intended to be used before there is a problem or in fixing flood damage.

Discussion

Rates of river aggradation in the park were unknown until a 2006 study. Using historical information, scientists compared current and earlier rates of aggradation. The historic background aggradation rate of rivers in the park varied between one to six inches per decade, compared to the recent three or more feet per decade. At areas with recent debris flows, the aggradation is even higher, up to six feet in a single storm.

Even during the record flood of 2006, where down-cutting is normally expected, all rivers aggraded. In many places, park buildings and roads are literally within aggrading rivers, and several locations in the park are below rivers. This is the case at the main village of Longmire, 29 feet below the Nisqually River. This situation caused the majority of the dramatic damage to the park infrastructure following the November 2006 flood.

As a result of this study, investigators have attributed the dramatic increase in recent aggradation to global climate change. As temperatures increase, glaciers in the park recede. When the ice retreats, it exposes large areas of unconsolidated materials on very steep slopes, which are prone to land-sliding. These types of failures supply rivers with tremendous amounts of sediment and have caused several recent debris flows.

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Mountain Lakes Restoration

NORTH CASCADES NATIONAL PARK COMPLEX

Importance

North Cascades National Park Complex contains a diverse array of 561 mountain lakes and ponds. These isolated lakes, situated between 1,350 feet and almost 7,000 feet in elevation are sensitive indicators of environmental changes. As a general rule, lakes higher in elevation have lower temperatures, lower nutrient levels, and a decreased ability to compensate for acid deposition – thus, pushing the limits of survival for organisms living in mountain lakes.

The mountain lakes in the North Cascades are naturally fishless due to barriers such as steep and rugged nature of the glacially carved valleys and abundant waterfalls. Though lacking in fish, the lakes are far from barren of aquatic life. When the glaciers receded following the last ice-age (approximately 11,000 years ago), a wide variety of aquatic organisms gradually colonized the mountain lakes including plankton, invertebrates, and amphibians. In the absence of fish, these lakes developed characteristic ecosystems where frogs and salamanders have become keystone predators bridging terrestrial and aquatic habitats.

Status

North Cascades National Park Complex currently has 62 lakes containing introduced fish. Research conducted here and other parks has demonstrated that introduced fish have a negative impact on the amphibians, insects (such as caddisflies) and zooplankton, which all need these lakes to survive. Reproducing fish populations in naturally fishless lakes tend to over-populate these systems, causing the fish to outstrip their food resources. Not only does this reduce the abundance of many of the native species like the long-toed salamander, it also leads to unhealthy and poor-quality fish.

In particular, the spread of Eastern brook trout from mountain lakes risks placing these non-natives in competition with the native and threatened bull trout.

Right Park scientists using a gill net to study non-native fish in Lower Berdeen Lake (NOCA) NPS/NOCA.

Opposite Lower Blum Lake, NPS/NOCA

Discussion

Of the lakes that contain introduced fish, 27 contain high-density reproducing populations. Research conducted in North Cascades National Park Complex has demonstrated that these populations of fish are the most damaging to native ecosystems. Mountain lakes with high-density reproducing fish populations are priorities for active restoration: recovering native biological communities and natural food webs as well as protecting bull trout populations.

In the past, people thought they were improving the natural environment by stocking non-native species of fish. But, instead, the result has been negative impacts to the ecosystem and unhealthy and non-recreationally-rewarding fisheries. The restoration of 26 of these mountain lakes will occur through the simple act of discontinuing fish stocking. Not only is this a cost-effective and efficient means of recovering the natural biological communities, it will also allow anglers to continue to fish these lakes for several years until all of the fish are caught or die of natural causes. North Cascades National Park Complex staff are currently testing methods to actively restore nine lakes that contain high density reproducing fish populations. The goal of these efforts is to develop restoration methods which will enable the recovery of native ecosystems while minimizing the impact to non-target organisms. Spawning habitat exclusion is being tested in one lake, targeted gill netting is being used to remove fish from six lakes, and antimycin is being used in two lakes to restore native ecosystems and protect federally threatened bull trout.

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Fisher Reintroduction

OLYMPIC NATIONAL PARK

Importance

The fisher (*Martes pennanti*) is a dark, sleek, cat-sized member of the weasel family that once roamed coniferous forests throughout western Washington, including Olympic National Park. Because of their prized fur, their susceptibility to trapping, and loss and fragmentation of their preferred low-elevation coniferous forest habitats, fisher populations declined and eventually were extirpated throughout Washington during the mid to late 20th century. Nobody knows when the last fisher disappeared from Olympic National Park, although the last fisher was trapped near the Park in 1969.

Any ecosystem is incomplete without all its parts. Because the purpose of National Parks is to preserve and protect vignettes of primitive America for future generations, the missing pieces are acutely missed. Consequently, an important goal of the National Park Service is to reintroduce extirpated species to their native environments where feasible, and in so doing restore the richness of native plant and animal communities, and the diversity of natural processes that govern how Park ecosystems work.

In 2006, The National Park Service (NPS) and Washington Department of Fish and Wildlife (WDFW) forged a partnership with several other agencies and conservation groups to return the fisher to its native habitat in Olympic National Park. After lengthy planning and amidst a fresh snow on a cold January morning in 2008, the partners gathered to release the first of 11 fishers transported from British Columbia to their new home in the Park. This marked the first step in restoring a key player to the Park—the fisher—long known for its affinity for large trees, its secretive habits, and as a predator of small and medium-sized forest mammals.

Above Releasing a fisher, 2008.

Opposite A female fisher at Sol Duc, 2008.

Status

To date, biologists have released 90 fishers in seven of the 11 major watersheds that drain the mountainous interior of Olympic National Park. Biologists from the NPS, U.S. Geological Survey and WDFW are studying movements and establishment of the newly released fishers. Results are only now emerging and in most cases too preliminary to draw conclusions. We know, however, that fishers released into Olympic National Park have dispersed long distances—up to 99 kilometers (about 60 miles) to establish home ranges widely throughout the Park and on adjoining lands. In June, 2009, biologists documented the first litter of young fishers (known as kits) that were conceived and born to one of the first fishers released in 2008. As of March 2010, seven kits have now been observed. This provides confirmation that at least several fishers have adapted to their new home by finding a suitable den sites and mates that were also previously released into the park. Because transplanted fishers have successfully reproduced, biologists no longer know the exact number of fishers in the reintroduced population. Yet just a year into the project, fishers are now spotted on occasion within the Park and along the highways that encircle it.

Discussion

The project goal is to release as many as 100 fishers into Olympic National Park over a three-year period to establish a self-sustaining population. Having completed two years, we hope to release an additional 45 fishers during the winter of 2009/10.

The return of fishers to Olympic National Park is an 'adaptive management' project, a marriage between research and management designed to inform future management. Each released fisher is equipped with a small radio transmitter that allows biologists to monitor fisher movements, survival, home range establishment and reproduction. Ultimately this information will be used to track the success of the fisher restoration project and determine how fishers adapt to this new landscape.

This landmark effort culminates over ten years of interagency and non-governmental cooperation. Key funding and support has been provided by U.S. Geological Survey, Olympic National Park, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Conservation Northwest, Doris Duke Foundation, and Washington's National Park Fund. This project also benefits from the support and efforts of many individuals within the U.S. Forest Service, British Columbia Ministry of Environment, Makah Tribe, Elwha S'Klallam Tribe, British Columbia Trappers Association, Washington Department of Natural Resources, and the University of Washington.

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Island Marble Butterfly

SAN JUAN ISLAND NATIONAL HISTORICAL PARK

Importance

The reappearance of the rare Island Marble butterfly on San Juan Island after nearly 100 years continues to intrigue researchers and enthusiasts throughout the century.

In 1998, the Island Marble (*Euchloe ausonides insulanus*), thought to be extinct since 1908, was discovered by Washington DNR biologist John Fleckenstein during a butterfly survey at American Camp. The only known specimens had been previously found on Vancouver Island and Gabrioloa Island in British Columbia.

After several years of surveys in potential habitat around Puget Sound, scientists believe the prairies of American Camp, along with scattered locations of San Juan and Lopez islands, are home to the only viable population of this subspecies in the world. The large marble butterfly (*Euchole ausonides*), is common east of the Cascade mountains: to date, no studies have been done to determine the exact genetic relationship between the two subpopulations. In 2005, the US Fish and Wildlife Service declined to list the Island Marble as threatened or endangered. Since that time, various agencies and groups have been working cooperatively to promote conservation of the butterfly. Scientific studies of the butterfly and its habitat are crucial for those efforts.

Status and Trends

A study begun in 2008 at American Camp and Friday Harbor is providing new insights into the natural history of the butterfly, including how far it flies, how long it lives and whether gender ratios vary in different areas. Dr. Merril Peterson, a biology professor and entomologist at Western Washington University, designed a protocol to capture, mark, release and alter recapture butterflies at four sites: three at American Camp and another in Friday Harbor. The survey is sponsored by the U.S. Fish and Wildlife Service in partnership with San Juan Island National Historical Park. Within the park, Dr. Peterson established a rectangular quadrat in the dunes east of Pickett's Lane, in the prairie southeast of the Visitor Center, and near Eagle Cove at American Camp, in addition to the former gravel pit near Pear Point.

Discussion

"We already have data about what the Island Marbles eat, where they lay their eggs and how long it takes for eggs to become caterpillars," said park biologist Todd Trapp. "We expect the mark recapture study will tell us more about how the butterfly uses its habitat and about its population dynamics." Trapp said the next step will be to determine if it can adapt to feed and laying eggs on native rather than the nonnative mustards it is currently utilizing at American Camp. The answers to these questions will be critical in determining how the park will incorporate native mustard plants into its ongoing prairie restoration plan.

"The goal of restoration is to increase native prairie habitat, and at the same time, safeguard the Island Marble butterfly," said park superintendent Peter Dederich.

The Island Marble is white and pale, with a mottled pattern of greenish-yellow under its hind wings. Look in the grassy prairie near wild mustard plants. It is easily confused with the more common Cabbage White, which is mostly white with a yellow underside and feeds on the same plants.

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Notes

The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations.

The National Park Service Mission